

for depositing a platinum based metal film by CVD deposition. A preferred embodiment of the present invention includes bubbling a non-reactive gas over an organic platinum based metal precursor until the non-reactive gas is saturated with the precursor. The platinum based metal film is then deposited onto a substrate in a CVD deposition chamber in the presence of both oxygen and nitrous oxide at a predetermined temperature and under a pressure of from about 10 to about 1000 Torr. The resulting film is consistently smooth and has good step coverage.

The present invention overcomes the drawbacks of the conventional methods and provides a CVD method that produces a smooth, uniform, continuous film of a platinum group metal that also has good step coverage. The present invention includes the addition of nitrous oxide ( $N_2O$ ) and oxygen in combination during the CVD process to control the deposition rate of the platinum group metal.

The present invention further provides a method for depositing a platinum metal on a substrate which includes the steps of flowing a gas having saturated therein a platinum precursor over the substrate at a selected temperature and pressure in the presence of both oxygen ( $O_2$ ) and nitrous oxide ( $N_2O$ ). The selected operating temperature is a temperature at which the platinum group metal deposits on the substrate, but less than a temperature at which the platinum group metal fails to smoothly deposit on the substrate. The pressure at which the process operates is a pressure at which the platinum group metal will deposit on the substrate in a continuous film while maintaining good step coverage. By carrying out this process, a platinum group metal film may be deposited on the exposed portions of the substrate in a uniform film.

Claim 1, as amended, recites a method for depositing a platinum group metal on a substrate which includes depositing said platinum group metal onto a substrate in a CVD deposition chamber in the presence of both oxygen and nitrous oxide at a predetermined temperature and "at a pressure of from about 10 to about 1000 Torr". Independent claim 6, as amended, recites a method for depositing a platinum group metal on a substrate

wherein the platinum group metal is deposited by CVD in the presence of both oxygen and nitrous oxide in a deposition chamber “at a pressure of from about 10 to about 1000 Torr.” Furthermore, independent claim 25 has also been amended to include the limitation that the platinum group metal is deposited onto the substrate in a CVD deposition chamber “at a temperature of from about 200 to about 600 °C and pressure of from about 10 to about 1000 Torr.”

Baum et al. (hereinafter “Baum”) relates to a liquid delivery for the transport of a platinum source reagent to a CVD reactor using a source reagent liquid solution which is volatilized to provide a vapor phase platinum source material for subsequent deposition from the vapor in the CVD reactor of platinum. Baum recites that the liquid solution precursor optionally in the presence of an oxidizing gas such as oxygen, ozone, nitrous oxide and mixtures thereof in a platinum CVD deposition process. (Col. 5, Lines 16-27). Baum is silent as to the operating conditions of the liquid delivery apparatus to be used in a CVD process other than to recite that the liquid delivery eliminates “the deleterious effects of having oxygen in contact with capacitor oxides at high temperatures(i.e.,  $\geq 500^{\circ}\text{C}$ ).” (Col. 5, lines 1-3).

Baum is silent as to the operating pressure of the CVD apparatus. To overcome this shortcoming, the Examiner first recites that “one would not have just blindly performed the process of Baum et al. without performing the reaction at a ‘predetermined’ pressure.” Office Action at 5. The Examiner then concludes that “it would have been obvious to have performed the process of Baum et al. at a predetermined pressure.” *Id.* However, there is nothing in Baum to disclose or suggest that the method be performed at a pressure of from 10 to about 1000 Torr as recited in independent claims 1, 6 and 25, as amended. In fact, Baum does not disclose or suggest the claimed method of platinum group metal deposition which includes depositing a platinum group metal onto a substrate in a CVD deposition chamber “in the presence of both oxygen and nitrous oxide at a predetermined temperature and at a pressure of from about 10 to about 1000 Torr” as

recited in claims 1 and 6 as amended. Furthermore, Baum does not disclose or suggest the method set forth in claim 25, as amended.

Thus, Baum does not disclose or suggest the methods set forth in claims 1, 6 and 25. Since claims 2-4, 7-10, 12-24, 26-36 and 46-55 depend from claims 1, 6 and 25 respectively, for at least these reasons these claims are also patentable over Baum.

Claims 6-36 stand rejected under 35 U.S.C. § 103 as being unpatentable over Baum in view of Kwon et al. (hereinafter "Kwon"). The Examiner concedes, as he must, that Baum does not disclose a pressure. To overcome the shortcoming of Baum, the Examiner relies upon Kwon to teach a pressure of 2 Torr in the CVD deposition of platinum. However, Kwon firstly does not disclose or suggest that the platinum deposition be conducted in the presence of oxygen and nitrous oxide as presently claimed. Furthermore, Kwon does not teach or disclose a pressure other than 2 Torr.

Baum in view of Kwon does not disclose or suggest that the CVD deposition method be performed at a pressure of from 10 to about 1000 Torr as recited in independent claims 1, 6 and 25, as amended. In fact, Baum in view of Kwon does not disclose or suggest the claimed method of platinum group metal deposition which includes depositing a platinum group metal onto a substrate in a CVD deposition chamber "in the presence of both oxygen and nitrous oxide at a predetermined temperature and at a pressure of from about 10 to about 1000 Torr" as recited in claims 1 and 6 as amended. Furthermore, Baum in view of Kwon does not disclose or suggest the method set forth in claim 25, as amended. There is nothing in this combination of references, without the improper use of hindsight reconstruction, to motivate the person having ordinary skill in the art to arrive at the instantly claimed method.

Thus, Baum in view of Kwon does not disclose or suggest the methods set forth in claims 1, 6 and 25. Since claims 2-4, 7-10, 12-24, 26-36 and 46-55 depend from claims 1, 6 and 25 respectively, for at least these reasons these claims are also patentable over Baum in view of Kwon.

Claims 1-36 stand rejected under 35 U.S.C. § 103 as being unpatentable over Kwon in view of Baum. As set forth above, the Examiner relies upon Kwon to teach a pressure of 2 Torr in the CVD deposition of platinum by bubbling argon over a platinum precursor. As conceded by the Examiner, Kwon does not disclose or suggest that the platinum deposition be conducted in the presence of oxygen and nitrous oxide as presently claimed. Furthermore, Kwon does not teach or disclose a pressure other than 2 Torr.

To overcome this shortcoming in Kwon, the Examiner relies upon Baum to teach a mixture of oxidizing agent which may include oxygen and nitrous oxide. Kwon in view of Baum does not disclose or suggest that the CVD deposition method be performed at a pressure of from 10 to about 1000 Torr as recited in independent claims 1, 6 and 25, as amended. In fact, Kwon in view of Baum does not disclose or suggest the claimed method of platinum group metal deposition which includes depositing a platinum group metal onto a substrate in a CVD deposition chamber "in the presence of both oxygen and nitrous oxide at a predetermined temperature and at a pressure of from about 10 to about 1000 Torr" as recited in claims 1 and 6 as amended. Furthermore, Kwon in view of Baum does not disclose or suggest the method set forth in claim 25, as amended. There is nothing in this combination of references, without the improper use of hindsight reconstruction, to motivate the person having ordinary skill in the art to arrive at the instantly claimed method.

Thus, Kwon in view of Baum does not disclose or suggest the methods set forth in claims 1, 6 and 25. Since claims 2-4, 7-10, 12-24, 26-36 and 46-55 depend from claims 1, 6 and 25 respectively, for at least these reasons these claims are also patentable over Kwon in view of Baum.

In view of the foregoing amendments and remarks, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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